

# Atrial Fibrillation Post Coronary Artery Graft Surgery: A Review Of Literature

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**Abstract:** Atrial fibrillation (AF) is a failure that is observed in heart disease and is also known to be the most common heart rhythm disturbance post coronary artery bypass surgery. Although AF is considered a transient problem, it is usually accompanied with a variety of complications and morbidity for patients and may result in death. In the present study, pre- and post-operative considerable factors which may increase the risk and mortality of AF, and possible treatments have been concisely reviewed.

**Keywords:** atrial fibrillation, cardiac surgery, mortality, risk factor, prophylaxis

## Introduction

Atrial fibrillation (AF) is a failure that is observed in heart diseases such as rheumatic and ischemic, as well as thyrotoxicosis and hypertension,<sup>1-3</sup> and it is also known to be the most common heart rhythm disturbance post coronary artery bypass surgery (CABS).<sup>4</sup> The incidence probability of AF is controversial; for example, of 700 000 patients who undergo open cardiac surgery in the US annually,<sup>5</sup> 11%–40% have AF.<sup>6</sup> Also, based on the results obtained with continuous electrocardiographic monitoring, the incidence range of postoperative AF has been reported to be 25%–40%, and up to 62% after a coronary artery bypass surgery or combined coronary artery bypass surgery and valve procedure.<sup>4,7,8</sup> On the other hand, according to the report of the Cleveland Clinic Foundation the prevalence of preoperative electrocardiogram AF incidence was very low (0.96%).<sup>9</sup> Nonetheless, AF still exists and its incidence has not decreased, in spite of the advancement of surgery, anesthesia and care methods post surgery.<sup>10,11</sup>

Although AF is often benign and transient, various factors, including prolonged length of stay, intensive care unit readmission, a greater need for reintubation, persistent congestive heart failure, stroke, and increased overall costs, have been recognized as associated with postoperative AF.<sup>12-16</sup> Typical conditions associated with the serious complications of AF include hemodynamic disorders, hypotension caused by the rapid ventricular response, myocardial infarction, cerebral apoplexy, increased length of hospitalization, and death.<sup>17-22</sup>

The etiology of AF does not indicate a specific factor and there are a number of factors which might lead to the incidence of AF. Potential factors that have been shown to play a role in the creation of atrial susceptibility to AF include: pericarditis, atrial injury from surgical handling or cannulation, atrial suture lines, acute atrial enlargement from pressure or volume overload, inadequate myocardial protection during cardiopulmonary bypass, atrial ischemia, long bypass and aortic

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cross-clamp times, hyperadrenergic states (such as the use of postoperative inotropic medications), pulmonary complications, hypoxemia, inflammation,<sup>23,24</sup> hypokalemia, and hypomagnesemia.<sup>25–27</sup>

Since the rate of AF incidence is considerably high and it could come with morbidities that annoy patients, it is a hot point of research in the field of cardiac science. Hence, in the present study we review some aspects of AF disorder after cardiac bypass surgery, including potential pre- and post-operative factors that might play a role in AF incidence, complications that arise with AF, risk of mortality, and management and treatment of AF such as prophylaxis procedures.

## Pre-Operative And Post-Operative Considerations Of AF

An understanding of the preoperative factors concerned with the incidence of AF would be helpful to minimize morbidities followed by AF, or even to assist prevention. Although some patients develop AF after cardiac surgery without showing any apparent predisposing factors, most patients present at least one clinical predictor. The main preoperative factors which enhance the risk of AF incidence have been summarized in Table 1. These risk factors include increasing age,<sup>1,28–31</sup> gender,<sup>32</sup> previous history of AF, increased left atrial size or cardiomegaly, mitral valvular disease (particularly mitral stenosis), previous cardiac surgery, chronic obstructive pulmonary disease (COPD), low-intensity physical activity in the year prior to surgery, elevated preoperative hemoglobin A1c,<sup>26,33</sup> obesity,<sup>34,35</sup> and Caucasian race. Other factors which are as significant as the former include absence of beta-blocker or angiotensin converting enzyme inhibitor (ACE inhibitor), pre-operative digoxin use,<sup>36</sup> low-dose dopamine,<sup>37</sup> higher pre-operative plasma concentration of brain natriuretic peptide

**Table 1** Potential Pre- And Post-Operative Factors Which Increase The Risk Of AF Incidence

Preoperative	Postoperative
<ul style="list-style-type: none"> <li>• Increasing age</li> <li>• Previous history</li> <li>• Mitral valvular disease</li> <li>• Previous cardiac surgery</li> <li>• Chronic pulmonary disease</li> <li>• Elevated hemoglobin</li> <li>• Low-intensity physical activity</li> <li>• Caucasian</li> <li>• Obesity</li> <li>• Gender</li> </ul>	<ul style="list-style-type: none"> <li>• Weight gain</li> </ul>

(BNP),<sup>1</sup> severe right coronary artery stenosis, preoperative increase in P wave duration on surface (>116 msec)<sup>38</sup> or on signal-averaged (> 140 msec) ECG.<sup>29,39</sup>

Also, as potential predicting factors, time of onset (elapsed time), weight gain, fluid distribution, and recovered hematocrit were compared between control and experimental groups.<sup>32</sup> In terms of elapsed time, it was shown that approximately 70% of patients experienced AF on either the third or fourth postoperative day. In terms of weight gain, 64% of patients gained between 2 and 8 pounds. By looking only at those patients who gained weight and excluding those who remained the same and those who lost weight, the percentage of weight gain rises to 72%. The results of the subject of fluid distribution showed that 66% of patients had a positive fluid balance which means patients gained more fluid than lost it. It might be regarding that 55% of patients with a positive fluid balance had 1000 mL, or more surplus, at the time of atrial arrhythmia. Concerning the hematocrit factor, 76% of patients with AF were able to recover a range of 70–100% of their original erythrocyte count.<sup>32</sup> Based on these results, excluding weight gain, fluid distribution and hematocrit recovery were similar between the two groups.

## Mortality As A Result Of AF

Although age is one of the factors that increases the risk of AF incidence and AF seems to be more dominant among older people, using appropriate and applicable statistical methods for studying large population (such as Framingham study) has demonstrated that postoperative AF is associated with reduced survival, independent of age.<sup>40</sup> AF incidence will be accompanied by morbidity and complications. According to the comparison between AF and non-AF patients, the length of hospital stay was demonstrated to be significantly longer in the AF group. Also, reports indicate a higher rate of early death and stroke in AF patients.<sup>12</sup>

Retrospective analysis on in-hospital outcomes of AF patients showed that these complications are not just excluded for myocardial infarction, but the probability of occurrence of other complications like stroke, respiratory failure, renal failure, hypotension requiring pressors, multi-system failure, shock, CP arrest, discharge on anticoagulants, and discharge on any antiarrhythmics was significantly higher in AF patients compared to non-AF groups.<sup>40</sup>

It has been shown that AF is associated with an increased risk of both early and late mortality. Albeit early death in the postoperative period dominates, late mortality is also shown to be statistically significant. This finding was more obvious after exclusion of early mortality cases from

the analysis and was even further strengthened by consistent findings in a simultaneous case-matched population.<sup>40</sup>

It should be noted that the mechanism of each of short- and long-term mortality as a result of postoperative AF is not similar. In short term mortality, the main AF incidence mechanism is the loss of atrial transport function directly followed by hemodynamic compromise and congestive heart failure (CHF). On the other hand, in the long term mortality, there is no clear mechanistic link and the most probable include adverse drug effect, the occurrence of disabling stroke and embolic catastrophes.<sup>41</sup>

## Management, Prevention, And Treatment

Postoperative AF is usually associated with a higher risk of stroke,<sup>42</sup> thus, strategies for preventing stroke should be considered seriously in this setting. Also, clinicians need to pay careful attention to the risk of hemorrhage following surgery, especially when they are going to consider anticoagulation in patients who have not been actively cardioverted. For patients who have been recognized cardioverted within the first 48 h of AF diagnosis with no more recurrence of the arrhythmia, the anticoagulation treatment is not necessary.<sup>43</sup>

Regarding the high probability of AF after cardiac surgeries, prophylaxis treatment has been strongly recommended especially when there is a risk factor.<sup>44</sup> Pieces of evidences have introduced class II  $\beta$ -blockers calcium channel controllers and also amiodarone (an antiarrhythmic drugs agent) as the effective prophylactic drug in controlling and reducing the risk of AF incidence after surgery.<sup>6,10</sup> Although several different strategies have been studied to reduce the incidence of AF after cardiac surgery, here, we mainly focus on the role of ADDs and B-adrenergic blocking agents (BBs) because they are widely available and have been proven efficient. Overall advantage and disadvantages of amiodarone treatment, as a model of a therapeutic agent, have been presented in Table 2.

**Table 2** Overall View Of The Advantages And Limitations Of Drug Treatment

Advantages	Limitations
<ul style="list-style-type: none"> <li>• Diminishing the rate of AF incidence</li> <li>• Shorter hospital stay</li> <li>• Lower hospital cost</li> <li>• Pre-operative consumption</li> </ul>	<ul style="list-style-type: none"> <li>• Dominance of other potential diseases</li> <li>• Bioavailability and pharmacokinetic matters</li> <li>• Possible side effects</li> </ul>

According to the 2006 American College of Cardiology guidelines, the American Heart Association, and the European Society of Cardiology for the management of AF, BBs was introduced as an impressive agent to prevent postoperative AF.<sup>45</sup> The effectiveness of BBs in diminishing the risk of postoperative AF has been supported in a large body of evidence. Atenolol, metoprolol, timolol, propranolol, and carvedilol are among the most studied agents in the postoperative setting and significant differences have been observed in relative efficacy of each of these agents. Based on contemporary practices, BBs can lower the risk of postoperative AF by approximately 30%, which means despite treatment, many patients would still develop AF.<sup>42</sup>

Among antiarrhythmic agents, amiodarone and sotalol are known to be more safe and efficacious in diminishing the risk of postoperative AF. Sotalol requires daily monitoring during the first five doses. Also, sotalol is dominantly cleared renally, and its use is not feasible in patients with renal dysfunction. In addition, in patients with complications like severe left ventricular dysfunction or congestive heart failure, amiodarone can be the drug of choice.<sup>43</sup> Comparative studies between amiodarone and placebo demonstrated that the initial treatment with amiodarone reduced the risk of postoperative AF compare with the placebo group. Also, amiodarone groups showed significantly shorter hospital stays and lower total hospital cost compared to the placebo group.<sup>46</sup> In another study, treatment of amiodarone significantly reduced atrial tachyarrhythmias and the risk of sustained ventricular arrhythmias.<sup>47</sup> In addition, it has been demonstrated that post-operative prophylaxis with intravenous infusion of amiodarone, followed by oral administration, significantly reduced the incidence of postoperative AF, total costs of care, length of intensive care unit and hospital stay.<sup>48,49</sup> Even, oral doses of amiodarone are sufficient to control cardiac arrhythmia.<sup>50</sup> It is worth noting that the possible difference in results between therapeutic treatments depends on dosage, duration of treatment, method of consumption (ie, injection, oral), cardiopulmonary bypass, and methods of stopping and continuing  $\beta$ -blocker consumption near surgery.<sup>50</sup>

However, in spite of the considerable positive outcomes of AADs in patients undergoing cardiac surgery, there are some significant clinical difficulties which limit the use of these agents. It is a fact that patients who undergo cardiac surgery usually have problems such as structural heart disease, coronary artery disease, or impaired left ventricular systolic function. Moreover, there are other factors which

might impact bioavailability and pharmacokinetics of ADDs agents in the early postoperative period; factors such as drug–drug interactions, first-pass metabolism, alterations in absorption, protein binding, impairment of elimination pathways and volumes of distribution. For example, in the case of amiodarone, drug–drug interactions are a major concern and need more attention to be paid. The above-mentioned factors contribute to the arrhythmia risk associated with sodium and potassium channel blockers.<sup>43</sup>

Also, pre-operative amiodarone prophylaxis has been shown to be useful to prevent AF occurrence in high-risk patients.<sup>51</sup> Oral consumption of amiodarone for a period of one week before surgery was stated to reduce AF manifestation by 50% and to decrease hospital cost and hospitalization duration by 25%.<sup>52</sup> On the other hand, consumption of amiodarone may be accompanied by side effects including bradycardia, ventricle arrhythmia, cardio block, interstitial pneumonia, and liver poisoning. Although the exact mechanism of the drug effects on AF after surgery is not clearly known, its effect is postulated to be in relation with the combination of antiadrenergic and Class I and II antiarrhythmic effects.<sup>53</sup> Overall effects of prophylactic methods on the term of hospitalization depend on the balance between decreasing the AF incidence, and as a result, decreasing the hospitalization duration on one hand, and increasing the side effects of the drug on the other hand.<sup>50</sup>

## Conclusion

Atrial fibrillation is a prevalent consequence of coronary bypass surgery which results in complications and morbidity for patients. Mortality outcome of AF might be present both long- and short-term, each followed by a different mechanism. Pre-operative factors such as age, gender, ethnicity, previous history of AF, and obesity can increase the risk of AF incidence. Also, post-operative factors like weight gain might be helpful to predict the risk of AF occurrence and to provide adequate precautions and care. Moreover, prophylaxis treatments, especially with antiarrhythmic drugs (AAD) and B-adrenergic blocking agents (BBs), have been shown as the most effective and available treatments which decrease the risk of AF incidence as well as length and cost of hospitalization. Prophylaxis treatments need specific consideration, regarding each agent, and might be accompanied with limitations and side effects; e.g. sotalol is not recommended for patients with renal failure and drug–drug interaction is of concern in the case of amiodarone. Nonetheless, amiodarone has shown an inhibitory role against AF incidence and

duration of hospitalization, even with oral administration and before surgery.

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## Disclosure

The author reports no conflicts of interest in this work.

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